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What's Happening

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Air Quality in the Lower Mainland: Patterns, Trends and Human Health

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Why was this report done?

There is much interest in air quality in the lower mainland. However, there is relatively little discussion of actual air quality data, including how the lower mainland compares to other cities, whether air quality is getting better or worse and its effects on health. Medical Health Officers of the four Health Regions within the lower mainland requested this report from Dr. M. Brauer of the School of Occupational and Environmental Hygiene at UBC in order to provide the public and air quality managers with information on these issues.

Dr. Brauer was asked to compare levels of air pollutants in the lower mainland with the levels found in cities of similar size in western North America. He was also asked to assess for the study period (1994-1998) whether concentrations of air pollutants were increasing, decreasing or remaining stable and whether there were local differences in the concentrations of air pollutants within the lower mainland. The Medical Health Officers also asked Dr. Brauer to estimate the annual number of deaths in the lower mainland that might be attributable to air pollution and to compare these numbers with other causes of death.

How do levels of air pollutants in the lower mainland compare with other cities?

Levels of air pollutants in the lower mainland were compared with cities of similar or larger size in Western North America. These cities included Seattle, Vancouver, Washington / Portland, Oregon, Denver, San Antonio, Minneapolis, Phoenix and several cities in California.

This comparison found the following:

Ozone - Ozone concentrations in the lower mainland were lower than in any of the comparison cities for which information was available.

Carbon Monoxide-Carbon monoxide levels in the lower mainland were lower than all but one (San Francisco-Oakland) of the comparison cities for which data was available.

PM10 - Generally PM10 concentrations in the lower mainland were lower than any of the comparison cities. Occasional higher readings occur at some monitoring stations in the lower mainland that would be in the mid-range of the comparison cities.

Nitrogen dioxide - Concentrations of NO2 in the lower mainland were in the midrange of the cities reviewed. Lower mainland NO2 concentrations were well below those found in Denver, Phoenix, Los Angeles or San Jose and somewhat higher than Seattle, Portland, San Francisco, Sacramento or San Antonio.

Sulfur Dioxide - Sulfur dioxide levels were relatively low in all cities (as one might expect for Western North America); SO2 concentrations in the lower mainland were slightly lower than those in Seattle and Denver, but slightly higher than Minneapolis, Los Angeles or San Francisco.

Is air quality getting better or worse?

For the period of this study 1994-1998, only carbon monoxide levels showed a change with time. CO levels are decreasing. The concentrations of the other pollutants, NO2, SO2, O3 and PM10 are stable. The results of this study are consistent with the results of a GVRD study for a 10 year period that also showed decreasing concentrations of CO in the lower mainland.

Do concentrations of air pollutants vary with the time of year?

Carbon monoxide levels are higher in the winter than summer. Ozone and PM10 concentrations have the reverse pattern with higher summertime concentrations. No seasonal trends are seen for NO2.

Do some parts of the lower mainland have higher levels of air pollutants than other parts?

Yes and no. This depends on the pollutant.

The highest concentrations of carbon monoxide and nitrogen dioxide are generally found in the City of Vancouver, particularly in the downtown core.

The highest concentrations of ozone are found east of Vancouver and Burnaby. Regionally the area of highest concentrations varies from year to year but are found in the area from Pitt Meadows to Hope.

Particulate matter concentrations are fairly evenly spread across the entire region.

Is air pollution in the lower mainland having an effect on human health?

Yes, although levels of air pollutants in the lower mainland are lower than other cities, there is evidence that air pollution is responsible for illness and mortality in lower mainland residents. Our current understanding of the relationship between air pollution and human health is that even relatively low levels of air pollution are associated with effects on health.

How big are these effects?

Dr. Brauer was asked to estimate the number of annual deaths associated with air pollution in the lower mainland. Using relationships from a study conducted by Dr. Brauer and colleagues at UBC on daily mortality and air pollution in the lower mainland and assumptions about the number of days on which these effects occur, annual air pollution related deaths were estimated to range from 0-600.

The number of deaths estimated to occur is very sensitive to certain assumptions made in performing this type of calculation. Using different assumptions about the level of air pollution at which health effects begin to occur can have a dramatic effect on the estimated number of deaths. This is one important reason for the difference in the estimates for the number of deaths attributable to air pollution in Canada released by different organizations.

Because our knowledge of the relationship between air pollution and health outcomes is not complete, we will never know the exact number of air pollution related deaths and illnesses. The report indicates that as few as 0 or as many as 600 deaths per year in the lower mainland may be attributable to air pollution. These estimates are based on different assumptions about the number of days on which air pollution related deaths are occurring. Neither of these extreme estimates are particularly likely and a narrower but reasonable range of estimates is that **between 15 and 150 deaths per year in the lower mainland may be attributable to air pollution.**

In addition, there are many non-fatal episodes of illness attributable to air pollution that have not been estimated in this report. These effects include hospitalizations, emergency room and physician office visits, increases in symptoms and restriction of activity.

How does air pollution compare to other causes of death?

Air pollution is an important public health problem. About as many deaths in the lower mainland may be attributable to air pollution as from HIV, accidental falls or traffic accidents. On the other hand, deaths attributable to smoking are more than 10 times greater and those attributable to alcohol more than 5 times greater.

Who is affected?

Virtually all of the air pollution related deaths in the lower mainland occur in the over 65 age group. Evidence from other reports in the literature indicate that many of these people have some degree of pre-existing heart or lung disease that makes them especially vulnerable to fatal effects from air pollution. Children and others with asthma are also vulnerable to the effects of air pollution although the effect is likely to worsen their illness rather than cause death.

How does air pollution produce effects on health?

Most of the recent studies on air pollution and health are based on associations between changes in daily air pollution levels and changes in the number of hospitalizations, deaths or some other health measure. This type of study cannot tell us much about how air pollution produces effects on health. Other types of research are needed to provide more information on this.

Air pollution's effects on health are related primarily to the respiratory and cardiovascular systems. Many of the effects of air pollutants are not specific to a particular pollutant and general reactions such as irritation and inflammation may be important in how air pollution produces its effects.

Which pollutant is responsible for effects on health?

Air pollution in cities and many small communities is a complex mixture of particles and gases. In studies relating community air pollution and health it is very difficult to single out or to apportion effects to one air pollutant. There is evidence that pollutants formed as a result of burning fuels or other organic material are more harmful than natural materials such as windblown dust. It is thought that small particles that can be inhaled into the lung are more harmful than larger particles.

Conclusions

Air pollution is an important public health issue and is linked to illness and death in the lower mainland and elsewhere. This is true despite the fact that current levels of air pollution in the lower mainland are generally stable or lower than they have been in the past and that levels of air pollution in the lower mainland are lower than other major cities in western North America.

The extent to which current ambient levels of air pollutants in the lower mainland can be further reduced is questionable. For some pollutants, such as ozone, levels in the lower mainland are much lower than in other cities and in some cases not appreciably different than one finds at sites used as remote or background monitoring locations. However, the challenge in the next 10 to 30 years will be to prevent degradation of air quality in the face of rapid population growth.

Therefore, air quality management efforts in the lower mainland should emphasize measures that will prevent worsening of air quality in the future. Measures that produce short-term reductions in the pollutants going into the air are unlikely to be effective in dealing with the real air quality challenge facing the lower mainland. Planning and designing our communities to reduce fuel use in heating and transportation should be a high priority. The lower mainland is considerably behind many other urban centers in building transit infrastructure that provides an effective alternative to private vehicle use.

The design of our communities should encourage the use of walking, cycling and other non-powered means of transportation. This can result in increased fitness of the population and can reduce fuel use.

The link between air pollution and human health is through the ambient levels of common air pollutants in the air we breathe. The public and air quality managers should pay more attention to the levels of pollutants in the air we actually breathe. Changes in ambient concentrations of air pollutants, not emissions tonnage, should be the measure of our success or failure in addressing risks to human health.

With respect to the air quality monitoring network, the lower mainland has an extensive network of monitors that ranks among the best in the world. The network is designed to provide a regional perspective on air pollution. It was not primarily designed to address questions related to levels of pollutants around specific commercial, industrial or agricultural sources or roadside air pollution concentrations due to traffic sources. Many complaints from the public about air quality are related to the impacts of neighbourhood facilities. Air quality planners should take into account the impacts of facilities on neighbourhood as well as regional air quality.

Additional monitoring and research activities that could add to our knowledge on the relationships between air pollutants and health in the lower mainland should be undertaken. There is still much to be learned about the composition of fine particulate matter and other air pollutants in the lower mainland and whether there are differences in types of particulate (e.g. diesel exhaust) that may affect the health of children or other members of the population.

Finally, in addition to the direct effects of poor air quality on human health discussed above, the related issues of visibility, odours and greenhouse gases need to be incorporated into air quality management plans in the lower mainland. This would round out the air quality management plan to ensure that the wide range of health issues related to the air around us are monitored and improved.

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